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ABSTRACT

This paper focuses on British English. Such rules as might be devised for specification of segment length would have to take into account, among other factors, the lenis/fortis nature of the segments at syllable margins, degree of stress, the relation between a given syllable and others in the same rhythm group, the same relations within the word, possibly the overall utterance length, and certainly the overall tempo. For the purpose of the piece of research under discussion recordings were taken of the first mode, stress-unstress, with the open front vowel /ae/. It was already known that duration figures for all segments would be different with various syllable nuclei and that they would vary systematically. The intention was to find out what relations existed between syllable nuclei and syllable margins, what difference in terms of duration occurred when there was a falling pitch movement of the final stressed syllable, and what evidence was there for compensation withing the syllable and within the word. If it can be proved that major durational regularities exist in mathematical terms, then a description of broad classes of sounds, such as fortis stop consonants and peripheral/tense front vowels, in terms of standard duration, would have predictive value. (Author/HW)

Vowel and Consonant Durations in Falling Nuclei a paper given by Dr A. J. Baird at the Colloquium of British Academic Phoneticians in Bangor, North Wales, in April 1973.

I am concerned here with British English. Such rules as might be devised for specification of segment length would have to take into account among other factors the lenis/fortis nature of the segments at syllable margins, degree of stress, the relation between a given syllable and others in the same rhythm group, the same relations within the word, possibly the overall utterance length and certainly the overall tempo.

Nooteboom[1] has pointed out the duration discrimination is better for a sequence of equal intervals than for a single interval. This points to the need for measurement of duration in embedded speech material rather than in isolated words or phrases. If, as I believe, there is underlying rhythmicality in an utterance and it is this underlying organization on a temporal basis which enables the speaker - and possibly the listener too - to realise discriminatory duration with a high degree of accuracy, then it seems logical to start with utterances which are rhythmically simple when we attempt to measure duration.

It also seems to me reasonable to attempt to set up standard durations for such broad classes of sounds as fortis stop consonants, peripheral/tense front vowels and so on. Other experiments have shown that the acoustic correlates of these have a high degree of durational conformity. A description of these classes of sound in terms of standard duration would have predictive value if it could be proved that major durational regularities existed in mathematical terms. Hence the present inquiry.

The findings that I am about to discuss arise as a bye-

product of a larger research project conceived as a study of the influence of rhythm on segment durations. So it began, but I should be less inclined now to talk in terms of segments and more in terms of syllable nuclei and syllable margins. The original project covered the four front vowels and two rhythmical conditions, stress-unstress and unstress-stress. For the purpose of the piece of research under discussion now recordings were taken of the first mode, stress-unstress, with the open front vowel /æ/. It was already known that duration figures for all segments would be different with various syllable nuclei and that they would vary systematically. The intention this time was to find out what relations existed between syllable nuclei and syllable margins. What difference in terms of duration occurred when there was a falling pitch movement on the final stressed syllable? What evidence was there for compensation a) within the syllable b) within the word?

The measurements of duration were made on a UV light recorder, a direct writing oscillograph covering frequencies up to 8kHz with a photoflash timing system. A light weight direct print paper was used to record the trace which was photodeveloped by exposure at 30 cms to a fluoreseent light. The paper speed during recording was 10 cm/sec. The recordings on tape were made at a speed of 9.5 cm/sec.

As the subjects used were phonetically naive, the stimulus was presented in orthographic form. The ages of the subjects ranged from 23 to 43 years. There were

twelve of them. The results given relate to ten of these. Two were omitted because of difficulties in reading the oscillograph trace. The twelve were chosen from a larger group on the basis of a simple test of their psychological reaction to the conditions of recording. It was intended that the speech recorded should be as natural as possible.

An example of the orthographic stimulus follows. Each line was treated as a single intonation unit with the nucleus on the last word. For our present purpose the section measured was the last two words of each line. These were identical phonologically apart from the difference of pitch movement, a fall from mid to low pitch levels.

1. papper papper patter packer pabber padder paggerpagger
2. tapper tapper tatter tacker tabber tadder tagger tagger
3. kapper kapper katter kacker kabber kadder kagger kagger
4. bapper bapper batter backer babber badder bagger bagger
5. dapper dapper datter dacker dabber dadder dagger dagger
6. gapper gapper gatter gacker gabber gadder gagger gagger

Earlier more detailed experiemnts had shown that the durations of fortis and lenis stops in stress initial and stress final positions were distributed evenly about means which I refer to as the Mean Fortis Initial Duration and so on. Of course these durations varied in turn with different vowels in the stressed syllables. On this occasion measurements were taken, first of the initial consonant, then of C+V, C+V+C and C+V+C+V. The sole variable is the initial stop consonant. Initial consonants were classified as fortis or lenis and the figures which follow indicate the differences between these means.

Mean Fortis Initial Durations, followed by C+V, C+V+C, C+V+C+V.

Nucleus.	15.2	25.9	34.2	44.3
Premucleus.	15.9	25.7	32.6	40.8
	-0.7	+0.2	+1.6	+3.5*

Mean Lenis Initial Durations, followed by C+V, C+V+C, C+V+C+V.

Nucleus.	11.1	23.8	33.0	43.9
Premucleus.	12.1	24.2	32.1	40.6
	-1.0	+0.4	+0.9	+3.3*

Mean Fortis Initial and Lenis Initial Groups in Premuclear Position.

F.I.	15.0	25.7	32.6	40.8
L.I.	12.1	24.2	32.1	40.6
	+3.8*	+1.5	+0.5	+0.2

Mean Fortis Initial and Lenis Initial Groups in Nuclear Position.

F.I.	15.2	25.9	34.2	44.3
L.I.	11.1	23.8	33.0	43.9
	+4.1*	+2.1	+1.2	+0.4

When one compares nucleus and premucleus in the first two tables one gets the impression that compensation has taken place in the first C+V sequence, the stressed one in fact. This is what one would expect; van Katwijk[2] has found that in comparable nonsense syllables a downward pitch obtrusion corresponded with a shortening of the initial consonant and a lengthening of the following vowel, when compared with an upward pitch obtrusion. van Katwijk was concerned with pitch obtrusion as a correlate of stress. It is likely that in the premuclear groups measured here the obtrusion was an upward one and that the falling pitch on the nucleus corresponded in

durational terms with downward obtrusion. We know that downward pitch obtrusion and pitch fall are often perceived as the same.

The second set of comparisons given above relate Lenis Initial to Fortis Initial groups in prenculear and nuclear positions respectively. What is of interest here is not the significant durational difference in the initial consonants, which was predictable, but the fact that compensation appears to be gradual throughout the C+V+C+V group. In all the tables given above an asterisk denotes significance at 0.05. Since one cannot be definite about differences which are not so marked, it must be emphasised that these figures indicate no more than a trend, but an interesting one.

1. S G Nooteboom (1973) The perceptual reality of some prosodie durations. Journal of Phonetics 1 1 p.39

2. A van Katwijk (1970) Segment durations with different stress modes. IPO Ann. Prog. Rep. 5, 85-89 fig.